Michael R. Hilliard, Ph.D.

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My research and development efforts focus on mathematical analysis, visualization, simulation, and optimization techniques and leveraging emerging computational technologies to support analysis and decision making. My interests include visual analytics, hybrid simulation, and innovative optimization techniques including evolutionary algorithms. I have led and participated in large and small teams developing analytical tools and providing analysis products for a wide range of government sponsors including DOE, DOD, and DHS.

EMPLOYMENT

1983-Present, Oak Ridge National Laboratory

EDUCATION

CORNELL UNIVERSITY, Ph.D., 1983, Operations Research and Industrial Engineering
Concentration: Optimization & Game Theory; Minor: Applied Probability and Statistics.
FURMAN UNIVERSITY, BS, Mathematics, 1979, *magna cum laude, Phi Beta Kappa.*

MAJOR PROJECTS

- *Real-Time Lock Arrival Prediction (Corps of Engineers)* —led development of a prototype testing the use of vessel tracking technologies for managing traffic at locks on US rivers.
- *Evolution of the National Biofuel Supply Chain (LDRD)*—designed and led development of a large scale optimization model capturing the spatial distribution of feedstock selection, preprocessing, transportation, refinery location and ethanol distribution.
- *Biomass Location for Optimal Sustainability (DOE)*—implemented a spreadsheet-based optimization of switchgrass plantings in a watershed to balance profit and multiple water quality metrics.
- *Dynamic Microeconomic Agent-Based Simulation (DHS)* – led development of an agent-based simulation of the recovery of the Mississippi Gulf Coast labor market after a disaster, using a full-size synthetic population and the AnyLogic simulation tool.
- *Automated Tracking of Barges Carrying Hazardous Materials (DHS)*—led data analysis and experimental testing of GPS devices and a web-based system for tracking barges carrying dangerous chemicals on the inland waterways, predicting hazardous situations, and detecting anomalies.
- *Ohio River Navigation Investment Model (Corps of Engineers)*—designed components of an economic analysis system for long-range investment planning for the inland waterway (now the national standard). Performed economic and statistical analysis, developed documentation, reviewed research, and presented results at national conferences.
- *Rail Security Pilot Study (DHS*)—developed simulations of subway stations and applied results to field testing of concepts and technologies for securing transit systems.

- *Spent Fuel Logistics Modeling (DOE)*—developed simulations of loading spent fuel into casks and onto transport vehicles (rail cars, trucks, barges) at nuclear reactors using Arena simulation tool, as a component of a national modelling tool.
- *Air Mobility Command Planning and Scheduling System (USAF)*—led the development of heuristic and optimization-based scheduling tools for the efficient movement of military air cargo and passengers. Worked with USAF team to implement the system during Desert Storm and continued evolution of the tools for many years afterwards.

TECHNICAL SKILLS

Discrete mathematics and algorithm development
Interactive Visual Analytics using Tableau software
Discrete and continuous simulation modeling in Arena and ExtendSim
Discrete, continuous and agent-based modeling in AnyLogic
Advanced Spreadsheet models
Spreadsheet-based optimization
Modeling for large-scale optimizations (MIP) using CPLEX and GUROBI
Application of genetic algorithms
Game Theory
Technical writing

PROFESSIONAL ACTIVITIES

Member INFORMS
Committee on Marine Transportation System—Interagency Action Team on R&D goals
Committee Member for two studies by Naval Advisory Board (National Academy of Science)
Session chair at several ORSA/TIMS/INFORMS meetings
Publications include book chapters, journal articles and technical memoranda.

AWARDS AND HONORS

International Edelman Competition (Best application of OR). Finalist, 1991.
Martin Marietta "Super Team" Award, 1991.
Association of American Geographers Citation for the best applied project—1992 and 2002.
ORNL Sustained Contribution Award, Fall 1993.
ORNL Significant Event Awards, 1994, 1997, 2000.
Awards Night honoree, 2000-Technical achievement .

PUBLICATIONS

I have published articles in journals such as *Interfaces*, *Annals of Operations Research*, *Transportation Research Record*, *International Journal of Intelligent Systems*, and *OR/MS Today*. I have also co-authored papers with multi-disciplinary teams in *Environmental Management*; *Biofuels, Bioproducts and Biorefining; International Journal of Emerging Electric Power Systems*; and the *Journal of Computing in Civil Engineering*.

Major publications are listed at http://scholar.google.com/citations?user=byPknw8AAAAJ

PUBLICATION LIST

Book Chapters:

"The Computer as Partner in Algorithmic Design: Automated Discovery of Parameters for a Multi-Objective Scheduling Heuristic," *Impacts of Recent Advances in Operations Research*, editors R. Sharda, B.L. Golden, E.Wasil, O.Balei, and W.Stewart, North Holland, new York, 1989, with G.E.Liepins, M. Palmer, G. Rangarajan.

"Genetic Algorithm Applications to Set Covering and Traveling Salesman Problems," in *OR/AI The Integration of Problem Solving Strategies*, editors D.Brown, C. White, with G.E.Liepins, T. Richardson, and M. Palmer pub. Operations Research Society of America, 1990, Baltimore, MD.

Journal Articles:

"2013 feedstock supply and price projections and sensitivity analysis." Langholtz, M., Eaton, L., Turhollow, A. and Hilliard, M. (2014), Biofuels, Bioproducts & Biorefining. Article first published online: 12 MAY 2014 doi: 10.1002/bbb.1489

"Indicators for assessing socioeconomic sustainability of bioenergy systems: a short list of practical measures." Dale, Virginia H., Rebecca A. Efroymson, Keith L. Kline, Matthew H. Langholtz, Paul N. Leiby, Gbadebo A. Oladosu, Maggie R. Davis, Mark E. Downing, and Michael R. Hilliard. *Ecological Indicators* 26 (2013): 87-102.

"Comparing Scales of Environmental Effects from Gasoline and Ethanol Production." Parish E, Kline K, Dale V, Efroymson R, McBride A, Johnson T, Hilliard M, Bielicki J. *Environmental Management.*

"Multimetric spatial optimization of switchgrass plantings across a watershed," *Biofuels, Bioproducts and Biorefining*, Vol. 6:1, January 2012. Esther S. Parish, Michael R. Hilliard, Latha M. Baskaran, Virginia H. Dale, Natalie A. Griffiths, Patrick J. Mulholland, Alexandre Sorokine, Neil A. Thomas, Mark E. Downing, Richard S. Middleton.

"The PHEV Charging Infrastructure Planning (PCIP) Problem," *International Journal of Emerging Electric PowerSystems*: Vol. 11 : Iss. 2, Article 7 (2010). Dashora, Yogesh; Barnes, John W.; Pillai, Rekha S.; Combs, Todd E.; Hilliard, Michael; and Chinthavali, Madhu S..

"The Economic Foundations of the Ohio River Navigation Investment Model (ORNIM)," in *Transportation Research Record No.1871, Water Transport.* (2004) :13-23 with T. Randall Curlee, Ingrid K. Busch, Gbadebo Oladosu, Frank Southworth, David P. Vogt.

"Future Utilization and Optimal Investment Strategy for Inland Waterways: New Model From U.S. Army Corps of Engineers to Assist Policy Makers" in *Transportation Research Record No. 1871, Water Transport* with Langdon Jr, V L, and Busch, I K.

"Automated Airlift Scheduling: A Geographical Perspective," Association of American Geographers Citation Award for the best applied project in 1992.

"Scheduling the Operation Desert Storm Airlift: An Advanced Automated Scheduling Support System", *Interfaces* 22:1, (January -February, 1992). pp. 131-146.

"Credit Assignment and Discovery in Classifier Systems," in *International Journal of Intelligent Systems*, 6:1, (Jan 1991) 55-69.

"Genetic Algorithms: Foundations and Applications," in *Annals of Operations Research*, 21 (1989) 31-58.

"Alternatives for Classifier System Credit Assignment," *Proceedings of the 11th International Conference on Artificial Intelligence*, (Morgan Kaufmann Publishers, Inc., 1989) 756-761. (Refereed Proceedings)

NAS Study Reports
Committee on Naval Expeditionary Logistics, Naval Studies Board. Naval Expeditionary Logistics: Enabling Operational Maneuver from the Sea. *National Academy Press*.(1999).

Autonomous Vehicles in Support of Naval Operations. Committee on Autonomous Vehicles in Support of Naval Operations, National Research Council. *National Academy Press* (2005)

Magazine and Trade Publications:
"A New Computer System Meets MAC's Airlift Scheduling Challenge," *Airlift*, Summer 1991, with Ronald D. Kraemer, and Lt. Col. Charlie Davis.

"Mission (Not) Impossible: New Scheduling tool plays a pivotal role in the largest airlift in history," *OR/MS Today*, April 1991, with Ronald D. Kraemer.

"AI Helps C^3 Solve Many Military Problems," *Applied Artificial Intelligence Reporter*, (with M. L. Emrich, H-L Hwang, L. F. Arrowood).

Conference Proceedings:
Rebecca J. Hartman–Baker, Ingrid K. Busch, Michael R. Hilliard, Richard S. Middleton, Michael S. Schultze *"*Solution of Mixed-Integer Programming Problems on the XT5." Cray User Group Conference, Atlanta, GA. May 4-7, 2009.

Yangrong Ling; Mingzhou Jin; Hilliard, M.R.; Usher, J.M.; , "A study of real-time identification and monitoring of barge-carried hazardous commodities," *Geoinformatics, 2009 17th International Conference on* , vol., no., pp.1-4, 12-14 Aug. 2009
doi: 10.1109/GEOINFORMATICS.2009.5293426
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5293426&isnumber=5292806

Berry, J.B., C.J. Coomer, R.C. DeVault, M.R. Hilliard, P.J. Hughes, M.P. Ternes and G.P. Zimmerman. 2000. Case Studies in Sustaining DoD Readiness, 26th Environmental Symposium and Exhibition, March 27 to 30, 2000, Long Beach, Calif.; National Defense Industrial Association, Arlington, Va., Report No. P00-106353.

"Integrated Decision Support for Planning, Scheduling, Analysis and Execution in Complex Transportation Systems" *Proceedings of the US Postal Service Advanced Technology Conference* (Nov 30, 1992).

"Technology and the 21st Century Government Organization," (co-author with Bruce Tonn, Michael S. Bronzini, Richard T. Goeltz, and Margie Irby*) Proceedings of the 5th Advanced Technology Conference, United States Postal Service,* Nov. 30-Dec. 2, 1992.(recently translated into Korean.)

"The Application of Military Airlift Scheduling Techniques to the Federal Waste Management System Transportation System" *Proceedings of the High-Level Waste Management Conference*, Las Vegas, Nevada in May 1992.

"Diagnosis, Parsimony, and Genetic Algorithms," with W.D. Potter, B.E. Tonn, G.E. Liepins, and S.L. Purucker, *Proceedings of the Third International Conference on Industrial and Engineering Applications of Artificial Intelligence and Expert Systems*, Charleston, S.C. July 15-18, pp. 1-8.

"Learning Decision Rules for Scheduling Problems: A Classifier Hybrid Approach," *Proceedings of the Sixth International Workshop on Machine Learning*, Cornell University, Morgan Kaufman Publishers, Inc., 1989, pp. 188-200.

"Some Guidelines for Genetic Algorithms with Penalty Functions," *Proceedings of the Third International Conference on Genetic Algorithms*, Morgan Kaufman Inc., 1989 pp. 191-197.

"Machine Learning Applications to Job Shop Scheduling," *Proceedings of the First International Conference on Industrial and Engineering Applications of Artificial Intelligence and Expert Systems*, University of Tennessee Space Institute, June 1-3, 1988, ACM Press. (with G. E. Liepins, M. Palmer.)

"A Classifier system for Discovering Scheduling Heuristics," *Genetic Algorithms and Their Applications: Proceedings of the Second International Conference on Genetic Algorithms*, MIT, July 28-31, 1987. Lawrence Erlbaum Associates, Hillsdale, N.J. 1987. pp 231-235. (with G. Liepins, Mark Palmer, Michael Morrow, and Jon Richardson.)

"Greedy Genetics," *Genetic Algorithms and Their Applications: Proceedings of the Second International Conference on Genetic Algorithms*, MIT, July 28-31, 1987. Lawrence Erlbaum Associates, Hillsdale, N.J. 1987. (with Mark Palmer, and Michael Morrow.)

"Representational Issues In Machine Learning," *Proceedings of the International Symposium on Methodologies for Intelligent Systems* - Colloquia Program, Knoxville, October 25, 1986. pp 3-13. (with G. Liepins.)

"Genetic Algorithms as Discovery Programs," *Proceedings of the Twenty-Second Annual Meeting of the Southeast Chapter of the Institute for Management Science*, Myrtle Beach, Oct. 9-10. pp 119-121. (with G. E. Liepins.)

"Challenges in Applying Artificial Intelligence Methodologies to Military Operations,"*Proceedings of the International Symposium on Methodologies for Intelligent Systems*, Knoxville, October 22-25, 1986.

"The AI Aspects of Command, Control and Communications Problems," *Proceedings of the 22nd Annual Southeastern TIMS Annual Meeting*, Myrtle Beach, October 9-10, 1986. (with H.L. Hwang, M. L. Emrich, L. F. Arrowood).

Technical Reports:

"AMC Deployment Analysis System Database Specification," with Irene Robbins, J.C. Davis, I.K. Busch, C. Terry, et. al. , ORNL/M-6127 16 January, 1997.

"A Functional Description for the Airlift Deployment Analysis System," with I.G. Harrison, R.D.Kraemer, et. al., ORNL-6560, May 1991.

"The Bonneville Power Administration Conservation/Load/Resource Modeling Process: Review, Assessment, and Suggestions for Improvement," ORNL/CON-190, January 1986. (with B. Tonn, E. Holub).

"Review and Assessment of Bonneville Power Administration's Conservation/Load/Resource Modeling Process," ORNL/CON-179, May 1985. (with B. Tonn, E. Holub).

"MAPTIS Architecture Support Tool Standard Configuration I, User's Guide," April 1985.

"Weighted Voting: Theory and Applications," Technical Report Number 609, School of O.R. and I.E., Cornell University, August 1983. (also available from University Microfilms)

"Reapportionment by Weighted Voting,"Technical Report Number 533, School of O. R. and I. E., Cornell University, January 1982. (with W. F. Lucas, J. C. Maceli, and D. Housman).

Selected Presentations:

"Conceptual Framework for Analyzing the MTS within the Intermodal System," invited plenary speaker with Kenneth N. Mitchell at the TRB/CMTS conference on "Diagnosing the Marine Transportation System: Measuring Performance and Targeting Improvement. June 26-2, 2012, Washington, D.C..

"The Ohio River Navigation Investment Model: A Risk-based Investment Planning Tool," invited presentation at United Engineering Foundation Conference on Risk-based Decision Making in Water Resources Oct 15-20, Santa Barbara, CA.

"Gaining User Acceptance of Optimization Models" ORSA/TIMS Chicago, May of 1993.

"An Introduction to ADANS Models" at Linear Programming Conference sponsored by XPY/AMC at Scott AFB on April 2-3, 1992.

"Introduction to the Airlift Deployment Analysis System" at the RAND conference on Mobility Modeling, Jan 8, 1992

"Integrating an Automated Scheduler into a Decision Support System," ORSA/TIMS Orlando, March 1992.

"An Airlift Capabilities Estimation Model for the Military Airlift Problem," (co-author with Cheng Liu) ORSA/TIMS Orlando, March 1992.

"Scheduling the Operation Desert Storm Airlift," ORNL Physics Division Seminar, August 29, 1991.

"Scheduling the Operation Desert Storm Airlift: An Advanced Automated Scheduling Support System," Edelman Competition Presentation, Nashville, March 1991. (available on video cassette)

"Operations Research Lessons Learned from MACs Airlift Scheduling in Support of Operation Desert Storm," presented at ORSA/TIMS National Meeting, Nashville, March 1991.

"Learning Parameter Settings for a Scheduling Heuristic," presented at ORSA/TIMS National Meeting, New York, October, 1989.

"Automated Discovery of Job Shop Scheduling Heuristics," presented at ORSA/TIMS National Meeting, St. Louis October 1987.

"The Banzhaf Power Index," co author with William F. Lucas, presented at The International Conference on Game Theory and Application, Ohio State University, June 18-24, 1987.

"Genetic Algorithms: A Biological Metaphor for Learning," AAAS Symposium on Automated Reasoning and Machine Learning. AAAS National Meeting, Chicago, Feb. 14-19, 1987. (available on audio cassette)

"Genetic Algorithms as a Paradigm for Machine Learning," presented at ORSA Meeting, Miami, October 27-29, 1986. (with G. Liepins).

"The Future of AI: The Technology and the Dream," invited presentation at AI: The Emerging Technology, May 20-21, 1986, Montgomery, AL.

"An Algorithm for Constructing Weighted Voting Games," presented at the 12th International Symposium for Mathematical Programming, MIT, August 5-9, 1985.

"What is Operations Research?" invited presentation at Furman University. Sponsored by Pi Mu Epsilon, April 19, 1985

"Some Interpretations of Threshold Logic for Weighted Voting Games," presented at ORSA/TIMS national meeting, Chicago, April 25-27, 1983.

"Weighted Voting for County Boards in New York State," (co author with William F. Lucas and David Housman) presented at 793rd meeting of the American Mathematical Society, Bryn Mawr, March 16-17, 1982.